Building Research Establishment Digest

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Electricity distribution on sites

Digests 87 and 88 (1967) described the use of 'cubicles' of various patterns and functions to distribute electricity on building sites. Supply, distribution, transformer and outlet units of this type are now specified in a British Standard (BS 4363:1968) and their use is fully described in CP 1017:1969. The two earlier digests are therefore withdrawn and the present one is restricted to a brief description of the standard units and their use on building and construction sites.

Safety requirements and supply voltage

Construction work makes considerable use of electrical supplies. The risk of serious accident by electrical causes is greatest in damp conditions, such as are common on building sites; in addition, equipment and cabling are subject to frequent repositioning, and this increases the danger.

For site lighting other than floodlighting, and for portable and hand-held tools and lamps, the accident risk is reduced if a lower operating voltage is employed. A 110 V supply, with the centre-point of the secondary winding of a transformer earthed, so that the nominal voltage of the sub-circuit to earth (the usual shock current path) is only 55 V, has been selected as the most satisfactory compromise between safety requirements and working efficiency. It is still necessary even at this voltage, to take precautions, which should include a high standard of routine maintenance and periodic testing of all apparatus used.

With a properly designed system, voltage drop is not serious and the slightly heavier cables needed do not prove to be a disadvantage. It is now possible to obtain the whole range of portable power tools for 110 V working.

Contract planning

Electrical supplies for construction sites should be planned with as much care as is normally given to permanent installations. Electricity is required for motive power, heating and lighting for construction work and for space and water heating, cooking and lighting for staff and office accommodation. Demands on electricity are extensive, as the examples in Table 1 show; smaller portable tools such as saws, hammers, drills, sanders and grinding wheels are also widely used. The use of electricity for aggregate heating and drying-out processes to facilitate winter working and speedier construction is increasing; site lighting is an appreciable part of the total load in winter months.

Depending on the total load requirement for the site, and by arrangement with the Area Board, a 415 V supply for the site can be provided either direct or

Table 1. Electrically operated plant (415V three phase)

Plant	kW range
Tower crane hoist motor	2·25–60
Tower crane slew motor	1·00–11·00
Tower crane travel motor	0·75–7·50
Tower crane crab or derricking motor	0·75–7·50
Weigh-batching unit	6·00–15·00
Concrete mixer	1·00–15·00
Goods hoist	1·50–33·50
Passenger/goods hoist	5·50–33·50
Compressor	5·50–75·00
Conveyor	2·25–7·50
Pump	0·25–30·00
Timber sawbench	0·75–7·50
Concrete saw	0·75–2·25
Floor grinder and polisher	0·375–2·25

through transformers from a higher voltage intake. In either case, the contractor's responsibility begins at the entry of the 415 V supply to the site.

Site programme for the contractor

1 Arrange pre-contract meeting between responsible executives associated with the work.

2 Decide on electrical requirements of heavy plant, eg tower crane, hoist, compressor, concrete mixer. Prepare layout drawing showing siting and total electrical load. Decide position and layout of site offices, stores, canteen etc.

3 Apply to Area Board for supply. This might range from 10 to 300 kVA.

4 Provide electrical distribution equipment as follows:

415 V, 3-phase, 50 cycle, for fixed plant and movable plant fed by trailing cable.

240 V, single-phase, 50 cycle, for site offices and floodlighting.

110 V, single and three phase, 50 cycle, for local site lighting, portable tools and portable handlamps for general use.

50 V or 25 V single-phase, 50 cycle, for portable hand-lamps for use in confined and damp situations.

Carefully site these installations to minimise interference with construction work as it proceeds.

5 Following the provision of site staff accommodation, eg offices, canteen, toilets, stores, ensure that a satisfactory semi-permanent electrical installation is provided.

6 Connect heavy plant, eg tower crane, hoists, concrete mixers, compressors, to the distribution centre indicated at 4 above.

7 Install floodlighting, if required.

8 As building progresses, a responsible electrical engineer should advise on reduced voltage distribution for local site lighting and for the use of portable tools.

9 As the work pattern changes, a periodic review of electrical load deployment should be made. If this is done either monthly, or preferably weekly, additional ordering of equipment can often be avoided by redeployment of existing distribution equipment. Any equipment not in full use should be returned to store.

The equipment should be robust, well designed and reusable from site to site. The equipment described here has overall advantages of safety, efficiency and a high recovery value at the end of a contract if returned in good condition.

Unless sub-contractors specialising in this type of work are employed, the main contractor should employ staff to carry out the whole of the installation work or at least a nucleus to supervise it and satisfy themselves on the type of equipment, cabling, etc, to be used. Merely to write a specification and hand it to an electrical sub-contractor is not enough.

Distribution equipment

Electricity supplies should be distributed to the building site through distribution units meeting the requirements of BS 4363:1968. The units comprise the following:

Supply incoming unit (SIU) A unit to house the Supply Undertaking's incoming cable, service fuses, neutral link, current transformers and metering equipment and with provision for one outgoing circuit of 300 A, 200 A or 100 A maximum current controlled by switch and fuse or circuit-breaker.

Main distribution unit (MDU) Equipment for control and distribution at voltages up to 415 V three-phase and 240 V single-phase and fitted with 300 A, 200 A or 100 A isolator, lockable in the OFF position. The available outgoing supplies are controlled by moulded case circuit-breakers (MCCB).

Supply incoming and distribution unit (SIDU) The two foregoing units may be combined in a single unit.

Transformer unit (TU) A unit incorporating a transformer and with provision to distribute electricity at reduced voltage (usually 110 V); available for 240 V single-phase input (TU/1), or 415 V three-phase input (TU/3), or both (TU/1/3).

Outlet unit (OU) Facilities for the control, protection (by miniature circuit breakers) and connection of final sub-circuits, fed from a 32 A supply and operating at 110 V. The single-phase outlet unit (OU/1) has up to eight 16 A double-pole socket outlets; to either, a 32 A socket-outlet may be added but this is not controlled by a circuit-breaker.

Extension outlet unit (EOU) An extension outlet unit is similar to an outlet unit but is fed from a 16 A supply and does not incorporate protection by circuit-breakers. The single-phase extension outlet (EOU/1) has up to four 16 A double-pole socket-outlets and the three-phase unit (EOU/3) has two triple-pole socket-outlets.

Earth monitor unit (EMU) Flexible cables used to supply power at mains voltage to movable plant incorporate a separate pilot conductor in addition to the main earth continuity conductor. A very low voltage current passes between the portable equipment and a fixed monitoring device (EMU) through the pilot conductor and the earth continuity conductor. Failure of the latter will interrupt the current flow; the

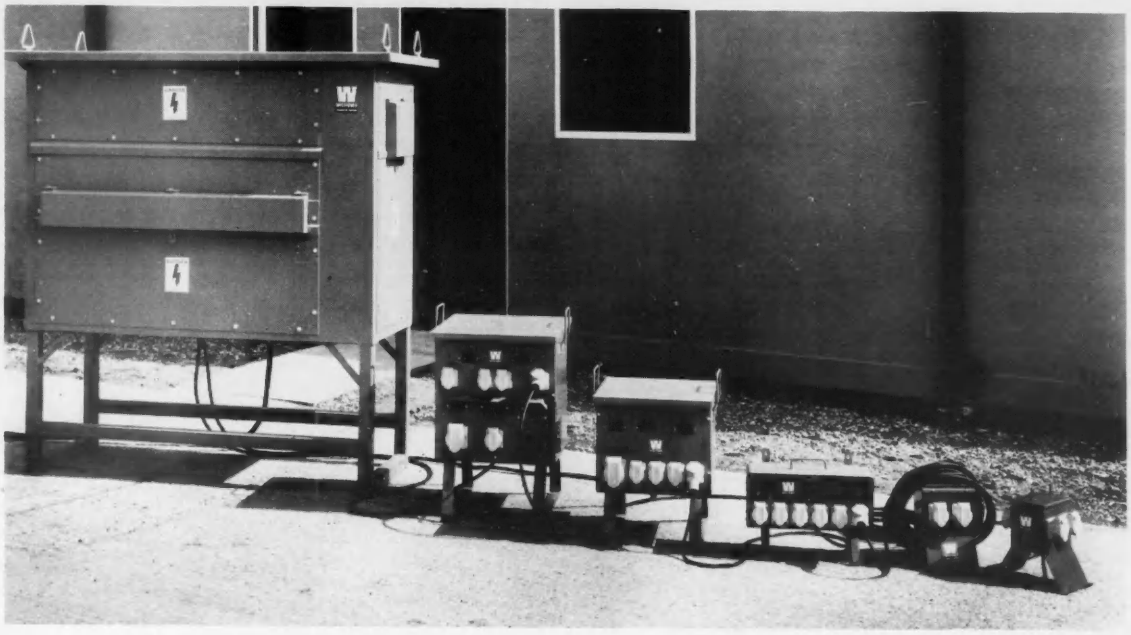

Fig. 1 Units for the distribution of electricity on sites
(Photo by courtesy of Wysepower Ltd.)

fixed monitoring device will detect this and automatically isolate the circuit.

Earth leakage circuit breaker A circuit-breaker with an operating coil which trips the breaker when the current due to earth leakage exceeds a predetermined safe value (30 mA is normally recommended).

Plugs and socket-outlets

The identifying colour for plugs and socket-outlets used in 110 V circuits is *yellow*. Colour identification of accessories operating at other voltages should be as shown in Table 2. Accessories should meet the requirements of BS 4343:1968 *Industrial plugs, socket-outlets and couplers for AC and DC supplies* which is based on International Standard CEE 17.

Cabling

For semi-permanent parts of the installation, eg site offices and ancillary buildings, the IEE *Regulations for the electrical equipment of buildings* state all the necessary requirements.

Cables should have a metal sheath and/or armour, which must be continuously earthed in addition to the earth core of the cable. The earthed sheath or armour must not be used as the sole earth conductor. Except where the risk of mechanical damage is slight, the cables should have an oversheath of pvc or oil-resisting and flame-retardant compound. If the voltage applied to a cable will not normally exceed 65 V, it may be of a type insulated and sheathed with a general purpose or heat-resisting elastomer.

Cables should be fixed on site so as to be clear of constructional operations and not to be a hazard to operatives. They should be kept clear of passageways, walkways, ladders, stairs and the like and should be at least 150mm clear of piped services such as steam, gas and water. Where they pass under roadways and access routes for transport, they should be laid in ducts at a minimum depth of 0·6m with a marker at each end of the crossing.

The use of overhead cables is deprecated but, if used, they should be fixed at a minimum height of 5·8m, or 5·2m in areas where motor transport and mobile plant are prohibited. They should be marked conspicuously either by yellow and black binding tape or with freely-moving fabric or plastics strips.

Table 2 Identification colours

Operating voltage	Colour
25	violet
50	white
220–240	blue
380–415	red
500–650	black

Maintenance

Site work is, of necessity, in a constant state of change and because of this the associated electrical installation is subject to risk of damage or misuse. Testing, strict maintenance and frequent checking of control apparatus and the wiring distribution system, by a competent person, are essential to promote safety and efficient operation.

Layout

Fig 2 shows a typical site layout using the distribution units specified in BS 4363. Fig 3 shows in greater detail how they could be used to provide supplies to a multi-storey building during construction. General floor lighting, access and security lighting are connected direct to transformer units. 1·5 to 3·0 kVA heavy portable tools can be connected through a 32 A socket-outlet on an outlet unit. In a layout such as Fig 3, it may be convenient to combine the supply incoming unit (SIU) and the main distribution unit (MDU) in a supply incoming and distribution unit (SIDU).

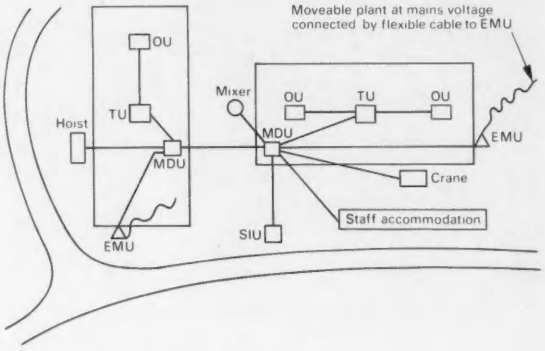

Fig. 2 Typical site arrangement

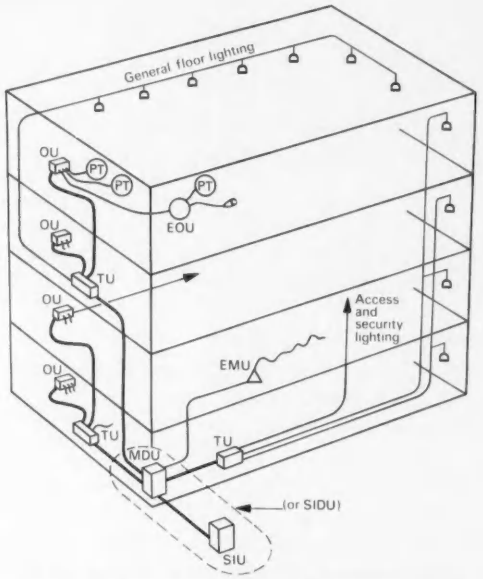

Fig. 3 Typical arrangement of distribution units

Further information

For further details, including references to the various sets of regulations which must be complied with, see BS 4363:1968 *Distribution units for electricity supplies for construction and building sites* and BS CP 1017:1969 *Distributing electricity on construction and building sites.*

Key

MDU	Main distribution unit	**EMU**	Earth monitor unit
SIU	Supply incoming unit	**OU**	Outlet unit
SIDU	Supply incoming and distribution unit	**EOU**	Extension outlet unit
TU	Transformer unit	**PT**	Portable tool (up to 1500 W)

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